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Theoretical and Numerical Studies of Variability and Predictability in an Unsteady Ocean

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LONG-TERM GOALS

Our long-term goals are to understand the nature of variability within the ocean, in particular that due to the motion of mesoscale eddies *and* their interaction with and dependence on the general circulation.

OBJECTIVES

Our particular objectives are to understand the nature, scales and amplitudes of mesoscale eddies in the ocean. This includes the mechanisms of their equilibration, their structure and energetics, and their dependence on the large-scale parameters set by the general circulation.

APPROACH

Our approach is to use a hierarchy of numerical and analytic models of the ocean circulation, of varying complexity. At the simplest level are linear quasi-geostrophic models of baroclinic instability. At the next level are nonlinear, eddy resolving quasi-geostrophic models in idealized domains. Finally, we employ eddy resolving primitive equation models in fairly realistic configuration and domain.

WORK COMPLETED

We have completed a sequence of integrations using a quasigeostrophic model to explore the equilibration properties of mesoscale eddies, with oceanically realistic stratification. We have configured a primitive equation numerical model to perform eddy resolving integrations of the Southern Ocean and subtropical gyres. We have performed, for the first time, some primitive equation eddy resolving experiments in which the abyssal circulation is equilibrated.

RESULTS

Progress has been made in understanding the mechanisms that determine the scale and equilibration of mesoscale eddies in the ocean. We have produced a scaling theory that predicts the scales and amplitudes of the mesoscale eddies as a function of the background stratification and shear, and we have made some progress toward incorporating these findings in a parameterization scheme for oceanic mesoscale eddies.

IMPACT/APPLICATIONS

The impact of this lies in understanding and predicting the nature of mesoscale eddies in the ocean, and its parameterization in ocean models.

TRANSITIONS

These results may be used to interpret the results of altimeter measurements and primitive equation numerical models.

RELATED PROJECTS

A related GFDL/NOAA funded project on modeling eddies provides an invaluable insight into eddies in the Southern Ocean, as well as the resources for the extensive primitive equation calculations.

PUBLICATIONS

Huck, T., and G. K. Vallis. 2001. Linear stability analysis of the three-dimensional thermally-driven ocean circulation. *Tellus,* **53A**, 526--545.

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